Silicon Nitride Rocket Thrusters Test Fired Successfully

Silicon nitride thruster. Left: Mounted in test stand. Right: Being tested with H_2/O_2 propellants.

In-situ-toughened silicon nitride offers high strength, low density, and good thermal shock resistance. In previous research on flat coupons at the NASA Glenn Research Center at Lewis Field, it was identified as one of the few monolithic ceramic materials capable of surviving the severe thermal shock and thermal gradients generated in hydrogen/oxygen rocket engines. To demonstrate this capability in a complex configuration, a team from Glenn and Case Western Reserve University used advanced rapid prototyping technology to fabricate a 1-in.-diameter, single-piece combustion chamber/nozzle (thruster) component. Compliant seals were used to attach the net-shape-fabricated uncooled thruster to a water-cooled metallic propellant injector assembly. Then, the thruster was successfully hot-fire tested with hydrogen/oxygen propellant. The thruster survived five cycles including a 5-min cycle to a 2400 °F material temperature. Silicon nitride can now be considered a viable candidate for some small rocket thruster applications. The research is expected to continue with increasingly larger and more complex geometries being fabricated and tested in a broad range of rocket engine operating conditions.

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Programs/Projects: Propulsion Systems R&T, Space Transportation